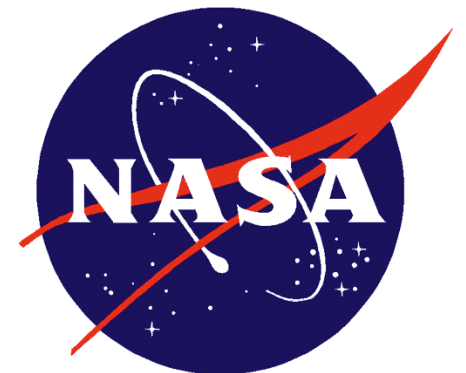




# MEASUREMENT IN MICROGRAVITY-INDUCED FLUID SHIFTS

Thomas Marshburn, Richard Cole,  
James Pavela, Kathleen Garcia, Peter  
Bauer, Ashot Sargsyan





# Disclosure Information

*85<sup>th</sup> Annual Scientific Meeting*

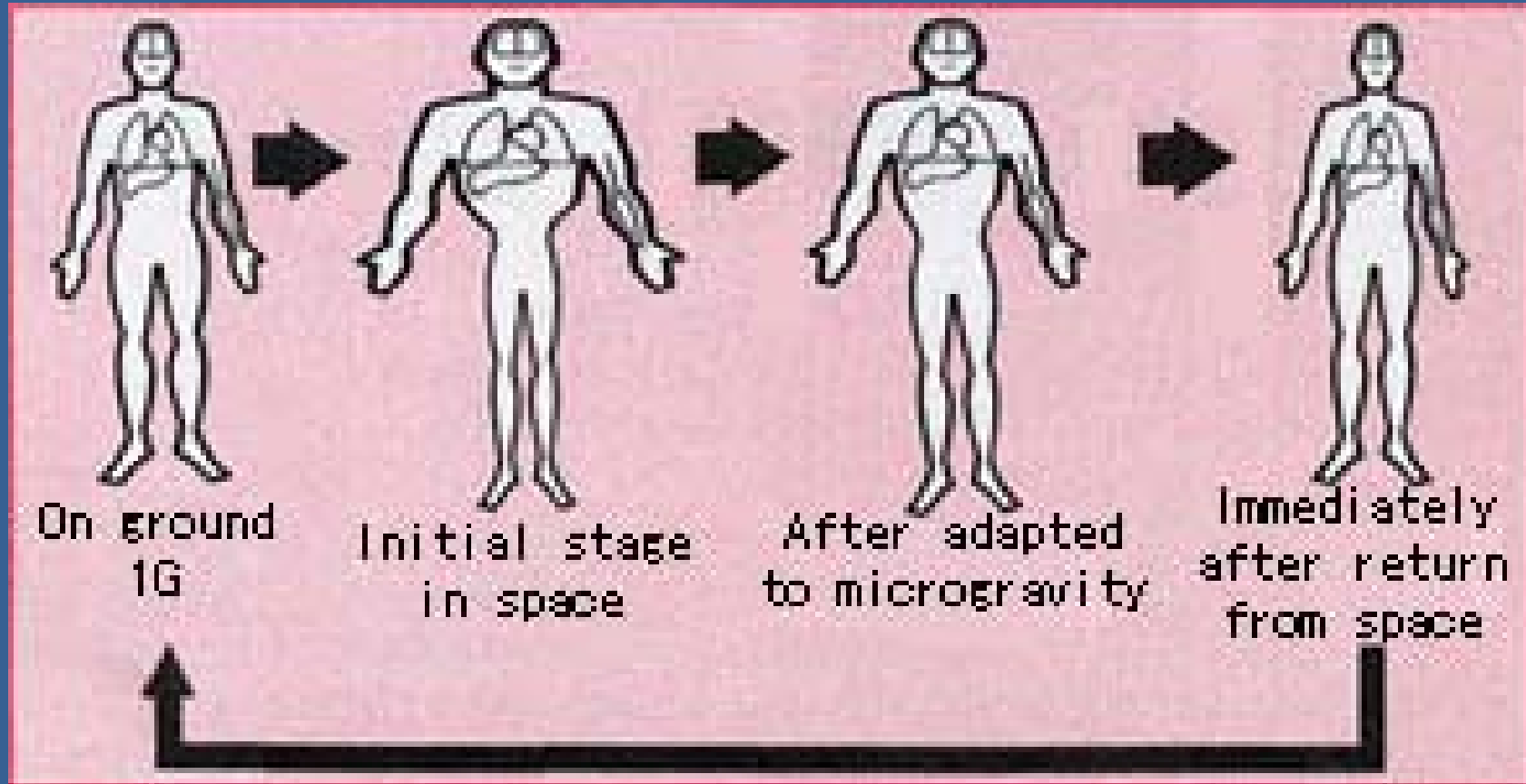
*Richard W. Cole, MD, MPH, FACEP*

I have no financial relationships to disclose.

I will discuss the following investigational use in my presentation:

1. Ultrasound use to measure facial soft tissue thickness

# Fluid Shifts Surrounding Space Flight



Credit: NASA

# Fluid Shifts During Space Flight



# Cardiovascular Countermeasures

- Fluid Loading
- G-Suits
- Exercise
- Meds
- LBNP
- Thigh cuffs (bracelets)



# Facial Tissue Thickness

## *Additional Factors*

- Hypergravity
  - Facial soft tissue thickness decreased 5% by 2G<sup>1</sup>
  - No change in if NPO after 2 hours
- Altitude and Humidity
  - Facial soft tissue thickness increased significantly (.34mm) over time @ 2500m and 15% humidity<sup>2</sup>
- Head down tilt increased facial soft tissue thickness by 5%<sup>3</sup>
  - After 8hr with thigh cuffs facial thickness decreased by 3%
  - Compared to stroke volume, carotid systolic diameter changes, vascular resistance changes, vein area changes

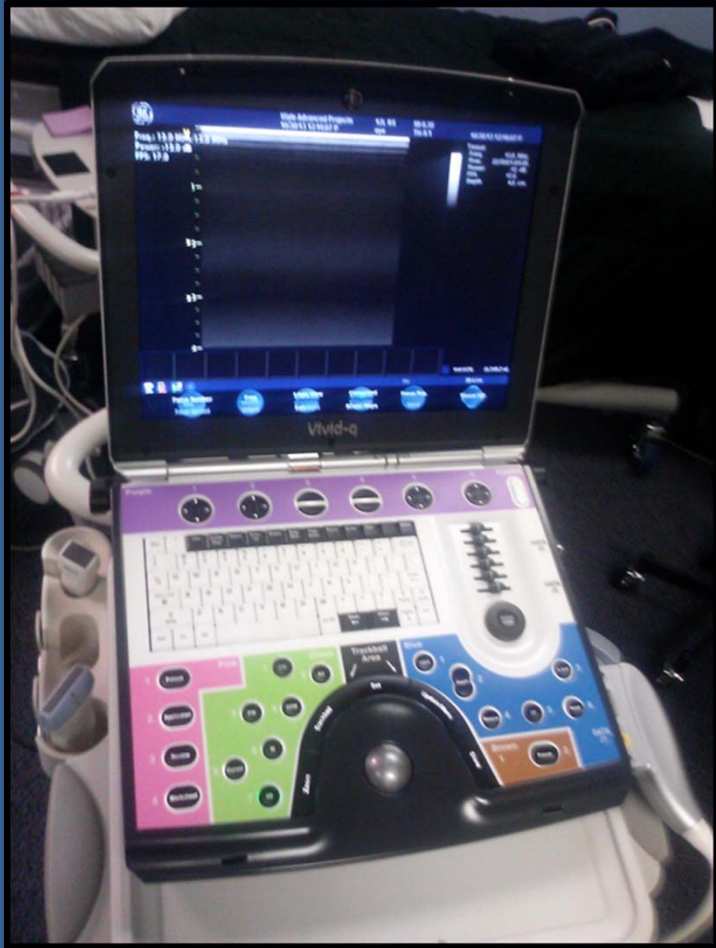
<sup>1</sup>Eichler, W., et al. Hypergravity and Dehydration-Induced Shifts of Interstitial Fluid in the Skin Monitored by Ultrasound. Aviation, Space, and Environmental Medicine. 75:9 760-763

<sup>2</sup>Iblher, P., et al. Interstitial Fluid Shifts in Simulated Long-Haul Flight Monitored by a Miniature Ultrasound Device. Aviation, Space, and Environmental Medicine. 84:5 486-49

<sup>3</sup>Arbeille, et al. "Effect of the thigh-cuffs on the carotid artery diameter jugular vein section and facial skin edema: HDT study." Journal of Gravitational Physiology, Vol 6(1), 1999.



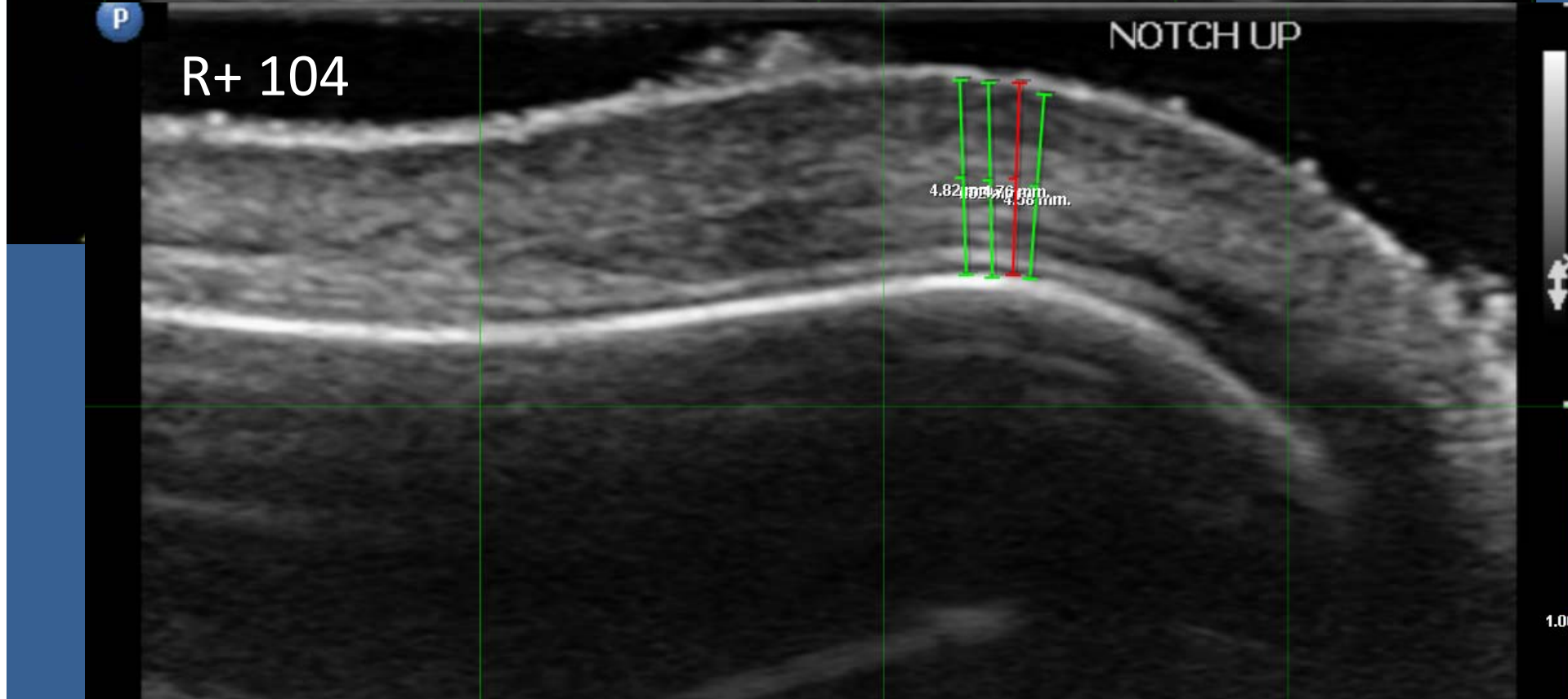
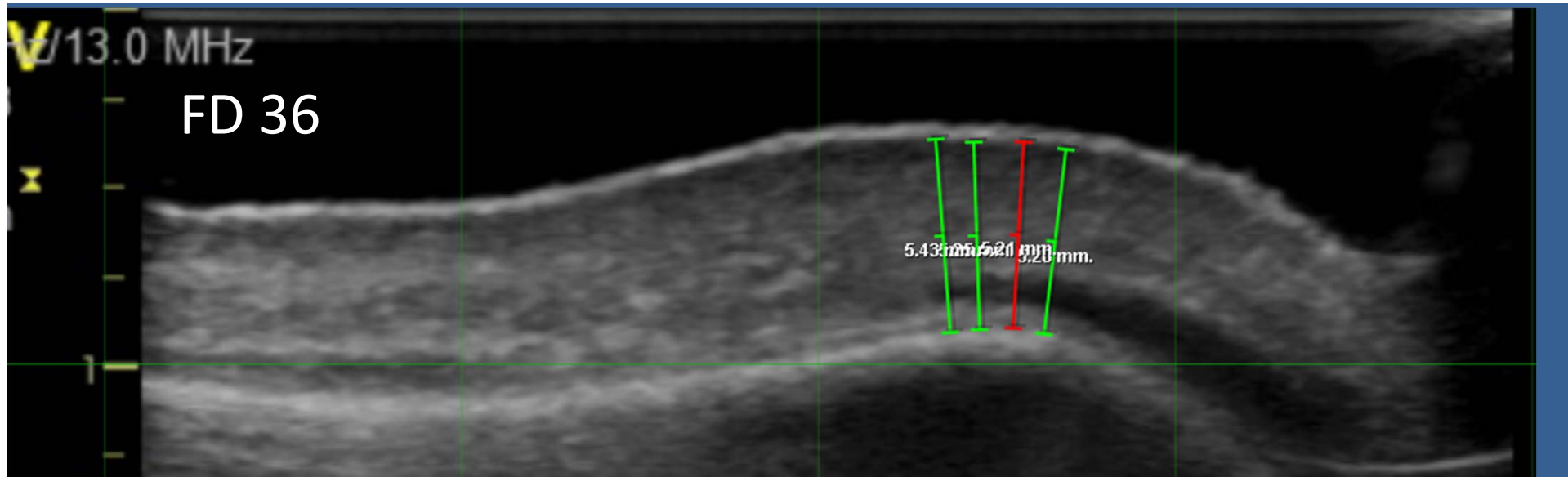
# Ultrasound Capabilities



# Procedure

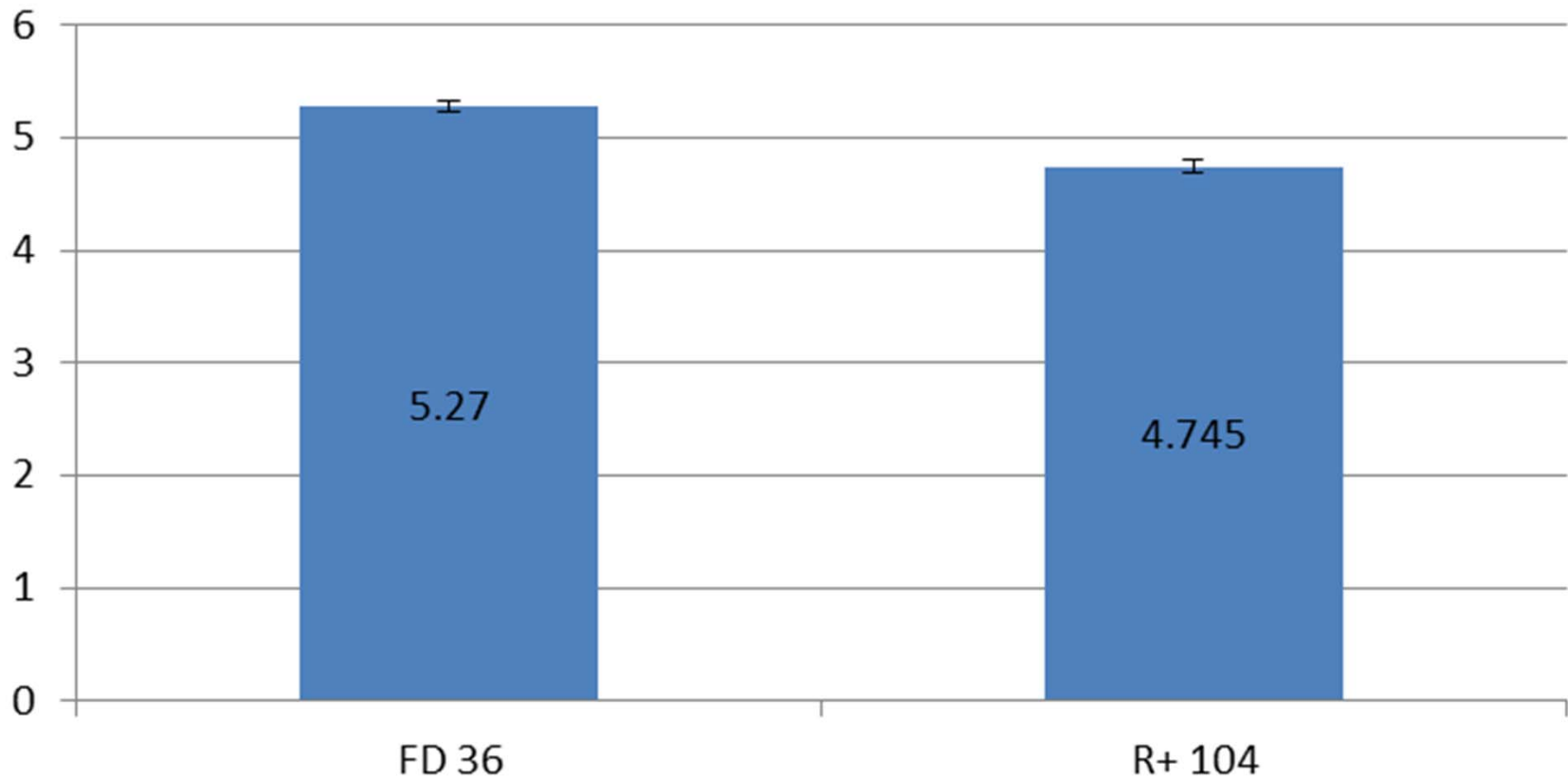






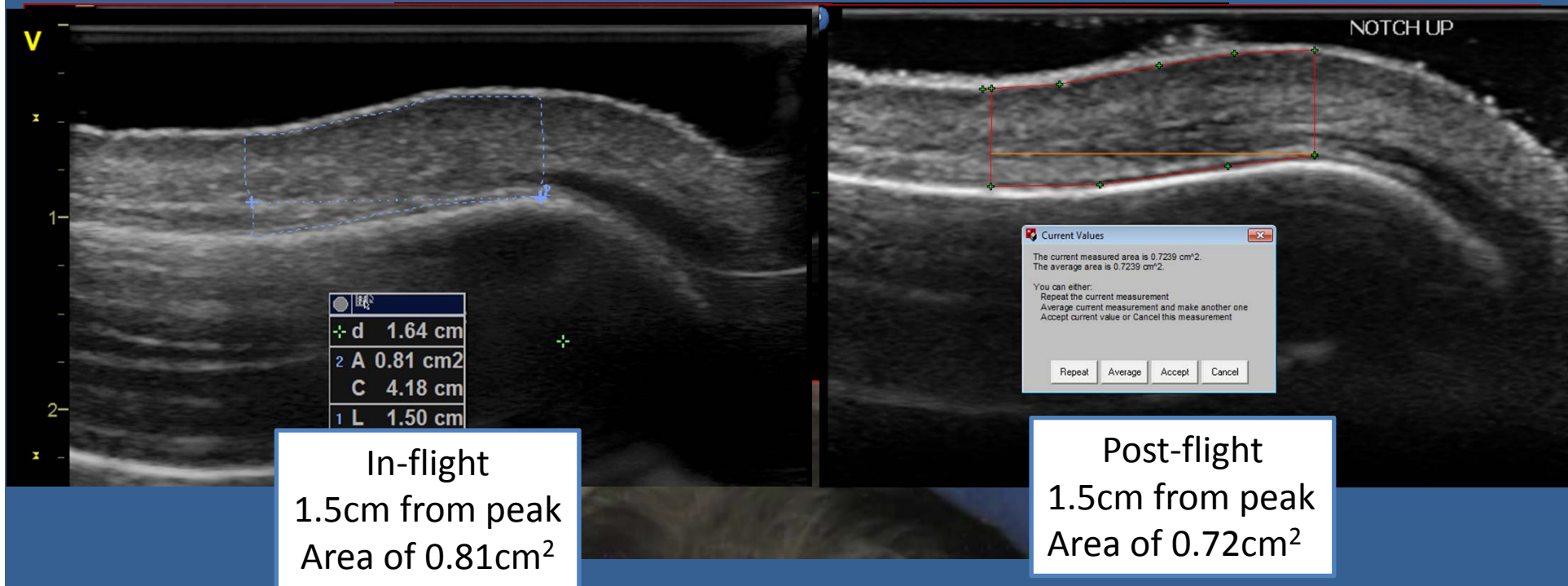
# Inflight to Postflight Comparison

## Tissue Thickness face (mm)



# Facial Tissue Thickness

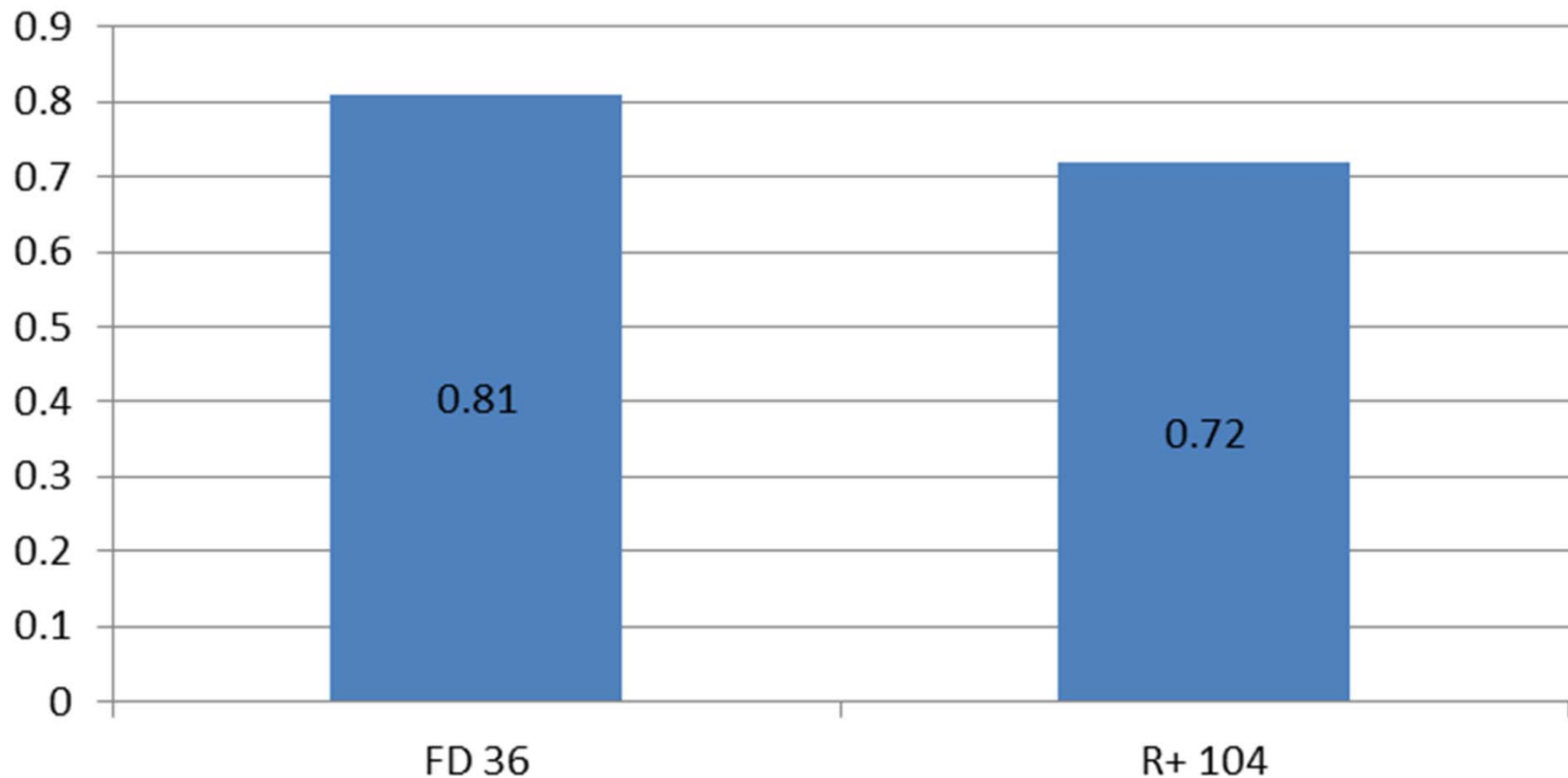
## *Area Measurement*



# Facial Tissue Thickness

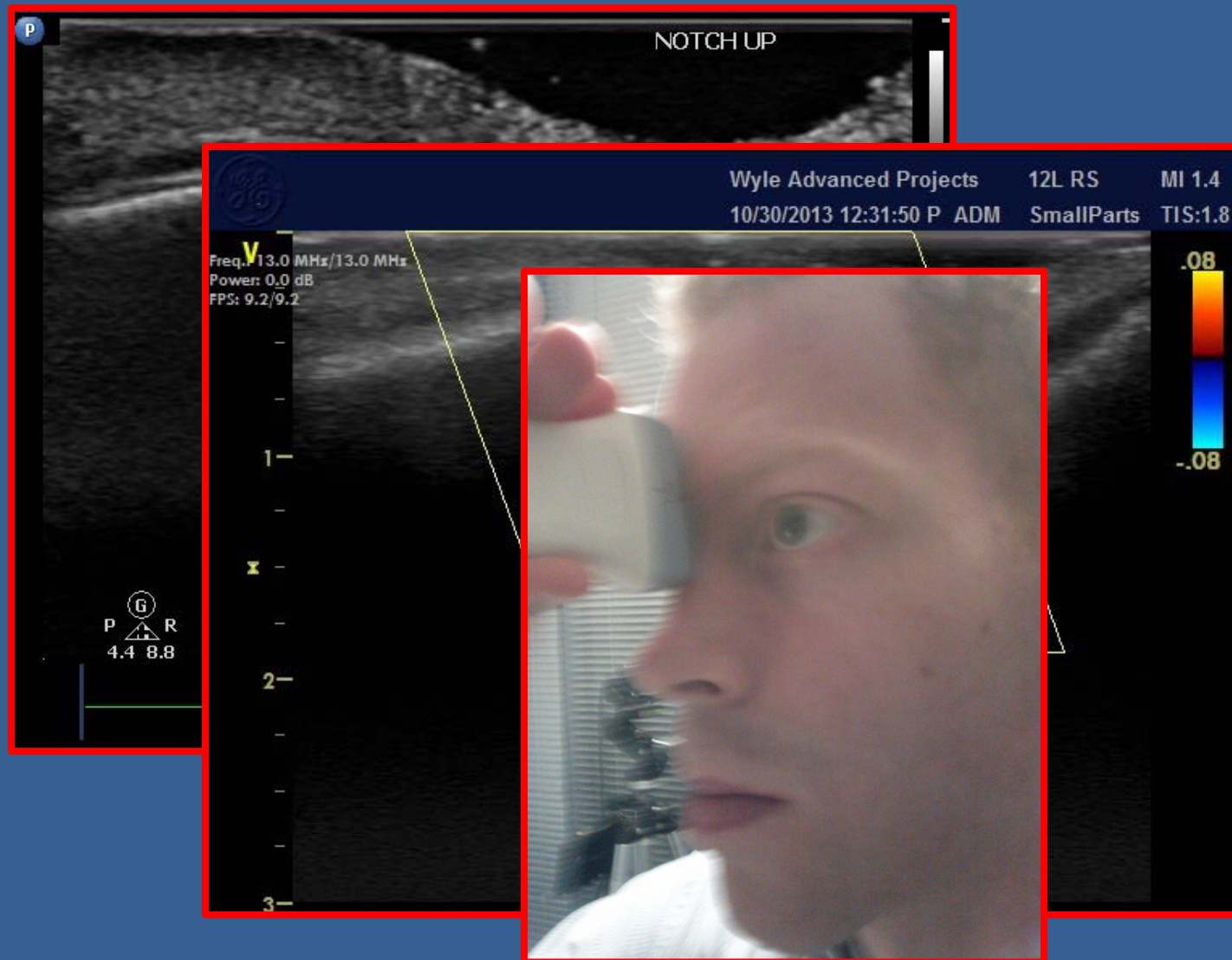
## *Area Measurement*

**Tissue Thickness face (cm<sup>2</sup>)**



# Facial Soft Tissue Thickness

## *Measurement Caveats*





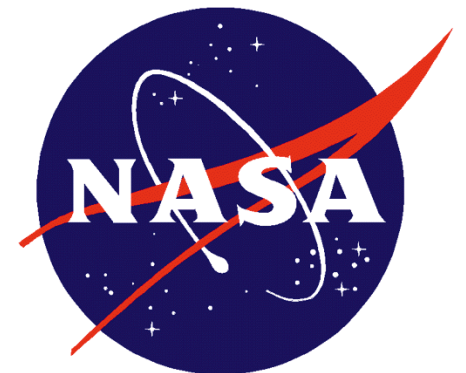
# Conclusion

- Facial tissue thickness measurement by ultrasound in microgravity is feasible
- Data suggests a decrease in facial tissue thickness upon return from microgravity
- Further study needed
  - Standardize technique across individual variability of local facial anatomy
  - Standardize technique of lower extremity
  - Objective tool to monitor fluid shifts, correlate with VIIP, evaluate countermeasures, etc.



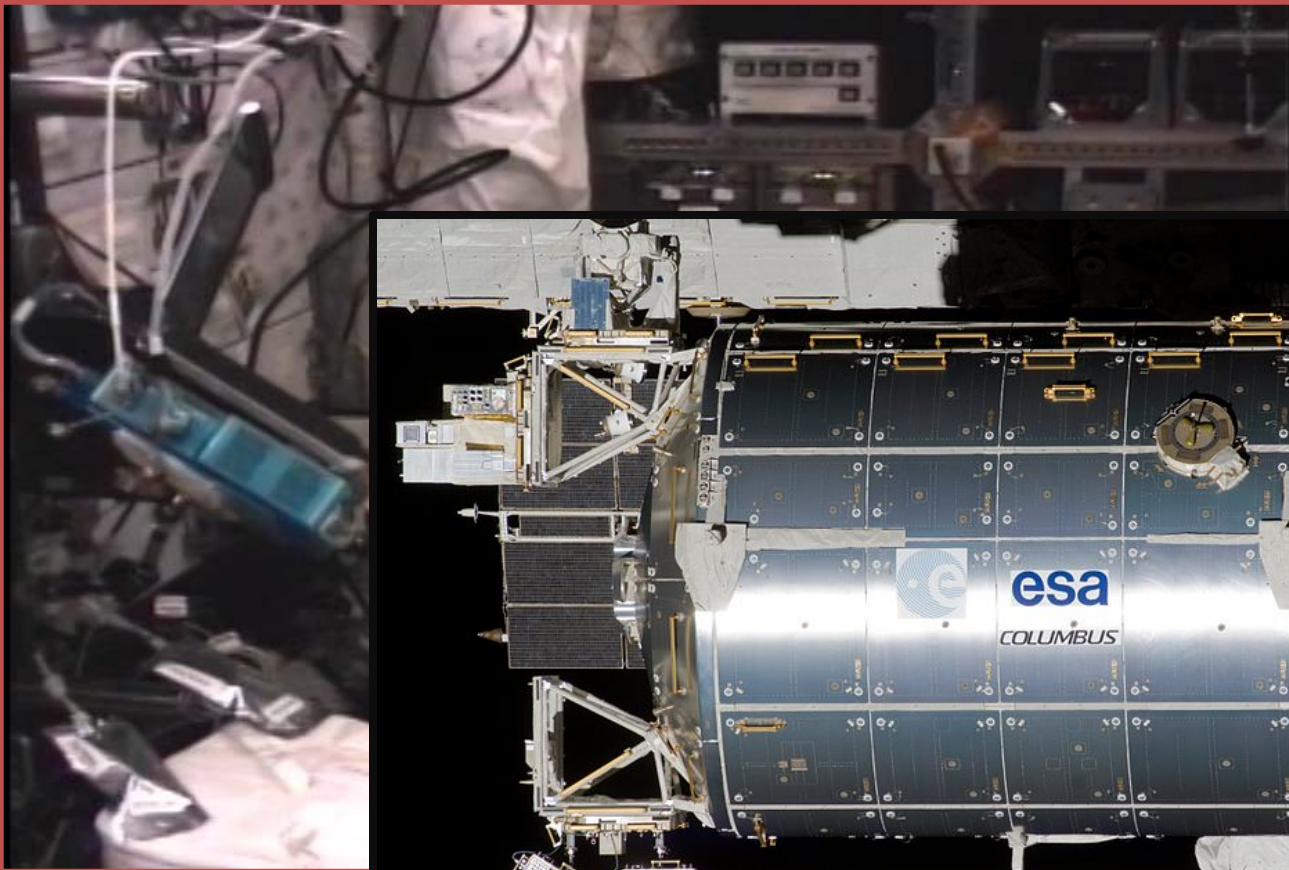
# Questions???

**wyle**



# Backup Slides

# Current Ultrasound



Setup: 30m/10m  
Stowage: 15m/10m

# Current Ultrasound - Probes

M4S – adult cardiac and abdomen

1

8C – pediatric abdomen, neonatal head (220 degree)

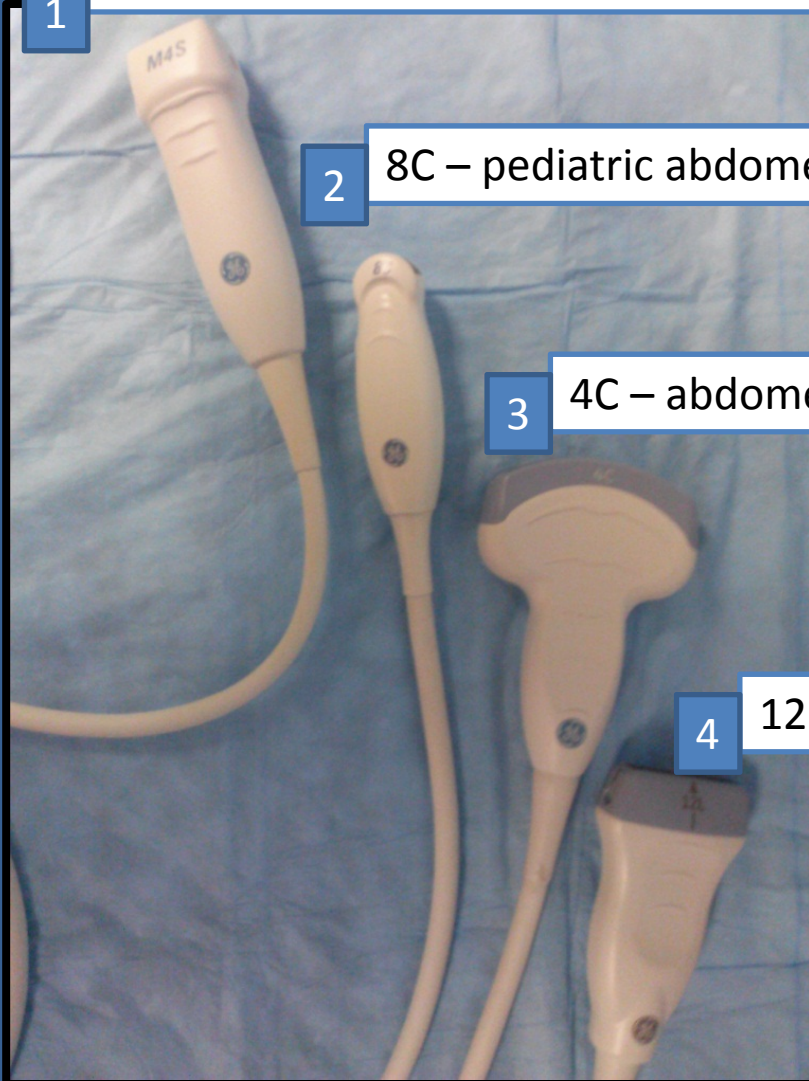
2

4C – abdomen, Ob/Gyn

3

12L – vascular, small parts

4





# Current Ultrasound - Telemed

[BACK TO Main Menu](#)

Remote Guidance

Overview

Commands & Terminology

Transducer

Keyboard

Checklist

PREVIOUS

NEXT

GE VIVID Q

Cx50

HD15

## PURPLE

Buttons number 1 through 6 change depending on mode selected. Select a mode below:

2D

Pulse Wave

Color Flow

Continuous Wave

### 2D function keys

- Width of sector; increase/decrease frame rate
- Frequency of Probe / 2.5 – 3.6 MHz fundamental / 1.5 – 2 MHz Octave = Harmonics
- Inverts the image & flips the image Left or Right
- Focal Zones; Gray Scale Mapping
- Focus Position (Carrot) on the screen
- Launches Power controls, Smart Depth, Tilt, Compress, Reject, DDP, UD Clarity, Dynamic Range, Contour and Diff

GE VIVID Q KEYBOARD